Berkeley Lab Nanotechnology Commercialized

Quantum Dot Corporation, Hayward, CA, has announced the introduction of five new products based on nanotechnology licensed from the laboratory of Paul Alivisatos at LBNL. The new products use nanometer sized “quantum dots” as the light emitting component in fluorescent probes for use in biological imaging. Due to the unique light emitting properties of the inorganic quantum dots, their performance is superior to that of existing materials, which rely primarily on organic dye molecules.

Fluorescent labeling is a widely used tool in the biological sciences. Antibodies to which fluorescent dyes have been attached bind to targeted proteins, revealing their location when viewed under a high resolution microscope with laser illumination. The fluorescent dyes now in use however, “photobleach” under repeated laser scans; their light emission weakens and eventually stops. Earlier work in the laboratory of Alivisatos had shown that inorganic nanoparticle “fluorophors,” such as cadmium selenide, are much more stable under prolonged laser illumination. They are also up to an order-of-magnitude brighter than conventional organic dyes. Furthermore, the size of the nanoparticles determines the wavelength (i.e. the color) of the emitted light and that size, in turn, is easily controlled in their solution-based synthesis. (MSD Highlight 99-7). Thus, a number of different sized dots, each targeted to a different cell structure, can be illuminated simultaneously to provide a multicolored view of the locations and interactions of these structures. Realizing the potential to make a robust and flexible fluorescent labeling scheme based on these materials, Quantum Dot licensed the LBNL technology.

The new products, Qdot™ 525nm Streptavidin Conjugate, Qdot™ 565nm Streptavidin Conjugate, Qdot™ 585nm Streptavidin Conjugate, Qdot™ 605nm Streptavidin Conjugate, and Qdot™ 655nm Streptavidin are aqueous solutions of quantum dots bound to streptavidin, a molecule which will bind any cellular structure to which another molecule, biotin, has been attached. The quantum dots emit light of the wavelengths in their names, corresponding to blue-green, green, yellow, red and deep red respectively. As a direct consequence of the photo-stability of the quantum dots, extended observation times can be used to improve sensitivity when small numbers of dots are bound. Further, the photostability allows repeated studies of the same sample over time.

Two papers in the January 2003 issue of *Nature Biotechnology* describe the use of these products. In one, a collaboration between Quantum Dot Corporation and the biotechnology company Genentech is described that uses quantum dots for the sensitive and specific detection of the protein Her2 which appears in increased amounts on the surface of certain breast cancer cells. (Wu *et al.*, *Nature Biotechnology* **21**, 41-46). In the other paper, a team from Rockefeller University described the extended use of quantum dots in live cells. They studied the cellular uptake of the dots carrying antibodies and their selective labeling of cell surfaces, demonstrating that the presence of the quantum dots did not affect cell function or growth for periods up to one week. (Jaiswal *et al.*, *Nature Biotechnology* **21**, 47-51).

These products are the first in a planned line of Qdot products for biological labeling that are based on this LBNL quantum dot nanotechnology. The company reports that any assay that currently uses fluorescent-tagged molecules, colorimetric enzymes, or colloidal gold, can be improved with Qdot nanocrystal-tagged conjugates.

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